NUCLEAR ENERGY RESEARCH INITIATIVE

Feasibility of Recycling Plutonium and Minor Actinides in Light Water Reactors Using Hydride Fuel

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Project Description

This project is designed to assess the feasibility of improving the Pu and minor actinide recycling capabilities of pressurized water reactors (PWRs) by using hydride instead of oxide fuels. There will be four general parts to this assessment: (1) identification of promising hydride fuel assembly designs for recycling Pu and minor actinides in PWRs; (2) a comprehensive system analysis that will compare the fuel cycle characteristics of Pu and minor actinide recycling in PWRs using the promising hydride fuel assembly designs identified in Part 1 versus oxide or inert matrix fuel assemblies; (3) a safety analysis to assess the likelihood of licensing hydride fuel assembly designs for PWRs; and (4) assessment of the compatibility of hydride fuel with cladding materials and water at typical PWR operating conditions.

Use of hydride instead of oxide fuel is expected to offer a number of improvements in PWR performance, PU/actinide inventory, and nuclear safety. In addition, there appears to be a good synergism between hydride fuel and the pyro-chemical separation process, thereby improving the economics and proliferation resistance of recycling in PWRs.

The three objectives of this project are to assess Pu and minor actinide recycling capabilities with hydride fuels, determine the compatibility of hydride fuel with PWR water and cladding, and study the safety of using hydride fuel in PWRs.

Workscope

Following are the major parts of this project:

- Identify promising hydride fuel assembly designs for recycling Pu and minor actinides in PWRs including zirconium-hydride based; thorium-hydride based; and composite U, Th-hydride, Zr-hydride fuel
- Conduct a comprehensive system analysis comparing fuel cycle characteristics of the promising hydride fuel assembly designs identified versus oxide or inert matrix fuel assemblies, in order to identify the best recycling options
- Perform a comprehensive safety analysis of PWR cores loaded with hydride fuel to evaluate whether the design is licensable
- Assess the compatibility of hydride fuel with water at typical PWR operating conditions and cladding materials